DRAFT

PROGRAM OF STUDIES

SCIENCE 10-20-30

CURRICULUM

LB
1629.5
A3
A35
1978
gr.10-12
add.sc.2
1988

CURRGDHT

ALTA
373.19
1978
gr.10-12
add.sc.2
1988

CURR

October 27, 1988

Digitized by the Internet Archive
in 2012 with funding from
University of Alberta Libraries

http://archive.org/details/shsscie10203088albe

DRAFT

PROGRAM OF STUDIES

SCIENCE 10-20-30

CURRICULUM

LB
1629.5
A3
A35
1978
gr.10-12
add.sc.2
1988

CURR HIST

ALTA
373.19
1978
gr.10-12
add.sc.2
1988

CURR

October 27, 1988

EX LIBRIS
UNIVERSITATIS
ALBERTÆNSIS

PROGRAM RATIONALE

> "The aim of education is to develop the knowledge, the skills, and the positive attitudes of individuals, so that they will be self-confident, capable, and committed to setting goals, making informed choices and acting in ways that will improve their own lives and the life of their community."
>
> *Secondary Education in Alberta Policy Statement (June 1985)*

In meeting this aim, students will need access to an academic science program suitable for university entrance, other than those programs that prepare students for entrance into the specific disciplines of science and engineering.

The Policy Statement sets further directions for science programs in that they are to:

- provide for the nature and needs of the individual learner;
- provide opportunities for all students to acquire basic scientific concepts;
- provide opportunities for all students to acquire a scientific and technological literacy background; and
- encourage values, standards, and examples of behaviour compatible with the expectations of society; to make choices, and to understand the consequences of those choices.

The framework for senior high school programs as laid down by the 1985 Policy Statement (page 24) requires that students have access to a three-course sequence in science in addition to the current biology, chemistry and physics for which a diploma examination is to be developed.

Global reforms in science education are unquestionably being directed toward science education for all students, under the umbrella goal of scientific and technological literacy.

Objectives emphasized in this program are in line with those set out by the Science Council of Canada in their discussion papers and Report 36: Science for Every Student, and the directions and guidelines of the 1985 Alberta policy paper.

PHILOSOPHY STATEMENT

The broad principles upon which the science programs are designed allow for all students to achieve scientific literacy within a balanced framework of concepts, skills and attitudes appropriate to their cognitive abilities. The major principles upon which the program goals would be based include:

- the retention of specific knowledge and understanding of the academic structure of science;
- an emphasis on an understanding of the nature of science, the development of process skills within the umbrella of critical thinking skills;
- an understanding of the relationship between science and technology;
- an understanding of the relationship between science and its social context;
- the development of lifelong interests, intellectual curiosity, and appreciation of science.

The cognitive focus of the Science 10-20-30 sequence would be for those students; who, while preparing for post-secondary education, are not proceeding into post-secondary institutions in the areas of science and engineering.

This three-course sequence satisfies the requirements of the Advanced High School Diploma.

GOALS

"The content and objectives of the secondary program of studies must be designed to:

- meet the goals of secondary education
- ensure that all students acquire basic knowledge, skills and positive attitudes through a broad base of general education
- ensure that all students are challenged to reach their full potential."

Secondary Education in Alberta (June 1985), page 21

To achieve this directive within the science programs, learners will need to set goals and to make informed choices as citizens of the future. They will need an array of thinking and problem-solving skills within a framework of scientific literacy such that they will:

1. acquire a foundation of knowledge in the natural sciences;
2. comprehend the nature of science;
3. understand the relationship between technology and science; and
4. understand the role of science and technology in societal issues.

GOALS AND OBJECTIVES

Goal 1
Foundation of Knowledge in the Natural Sciences

Objectives:

1.1 know some of the fundamental ideas of science:

- 1.1.1 structure and composition of matter, and the interaction among its components
- 1.1.2 conservation of matter and energy in reaction systems
- 1.1.3 interdependence of living organisms with one another and with their environment
- 1.1.4 uniqueness, diversity and changing nature of life forms
- 1.1.5 physical laws and theories attempt to explain the universe
- 1.1.6 chemical and physical systems are dynamic equilibrium systems

1.2 view such knowledge as part of a systematic explanation of natural phenomena

1.3 use the knowledge learned, when interpreting natural phenomena.

Goal 2
Nature of Science

Objectives:

2.1 understand that science is a disciplined way to develop explanations for the events and objectives of the natural world:

- 2.1.1 empirical data plays an central role in the development of scientific knowledge
- 2.1.2 scientific explanations are developed through interpretations and conceptual inventions which are theoretical in nature
- 2.1.3 theories may subsequently be supported or refuted by the results of experimentation

2.2 develop skill in the processes of science: questioning, acquiring data, proposing ideas, designing experiments, gathering, processing, and interpreting data into a unified theory

2.3 recognize that scientific knowledge is cumulative and subject to change.

Goal 3
Science and Technology

Objectives:

3.1 view technology as a means of solving practical problems

3.2 know that the scope of technological development includes both techniques and products

3.3 use scientific knowledge to explain and understand technological devices

3.4 know that science can be used to advance technology and that technology can be used to advance science

3.5 become familiar with some of the existing and emerging technologies.

Goal 4
Science, Technology, Society

Objectives:

4.1 understand that science and technology influence and are influenced by societal issues

4.2 understand that many of the effects of science and technology on society are unforeseen

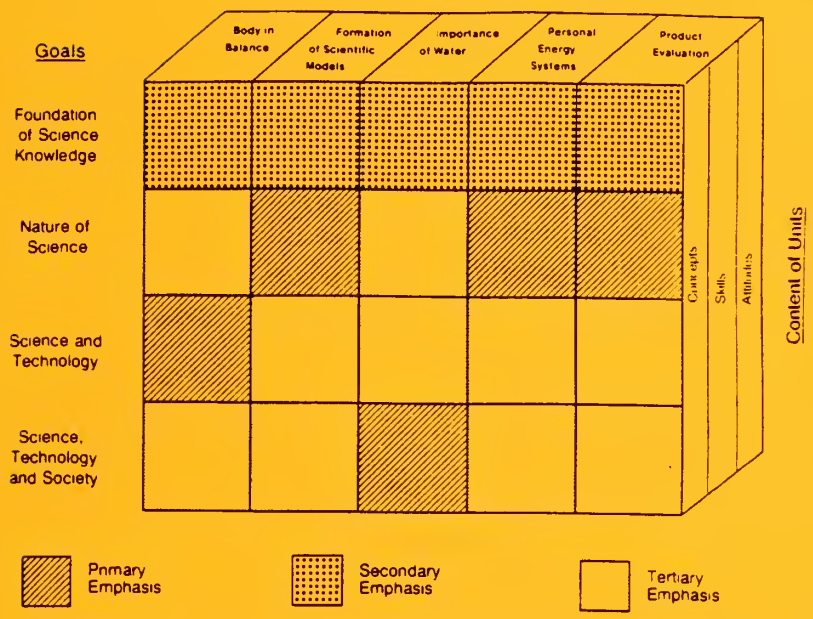
4.3 become aware of the interaction of science and technology with societal factors such as economic, political, ethical and moral forces

4.4 appreciate the societal impact of technological processes, techniques and products

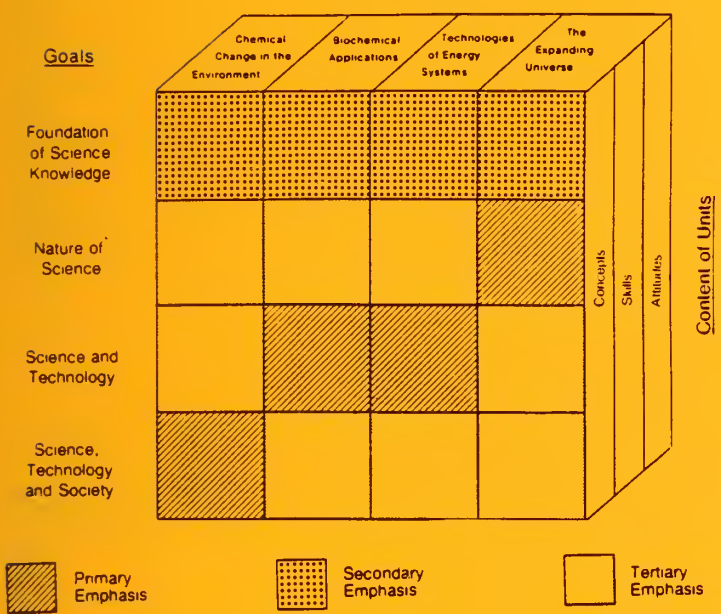
4.5 be aware that trade-offs are made in order to arrive at workable circumstances involving science and technology in society

4.6 evaluate the appropriateness of various societal decisions in terms of related scientific and technological thinking.

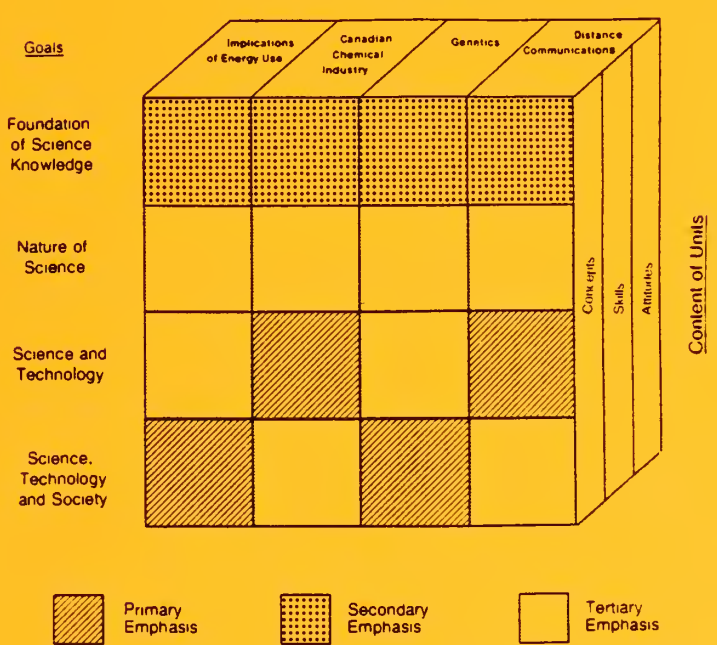
SCIENCE 10 SCOPE AND SEQUENCE
UNITS OF STUDY



SCIENCE 20 SCOPE AND SEQUENCE
UNITS OF STUDY

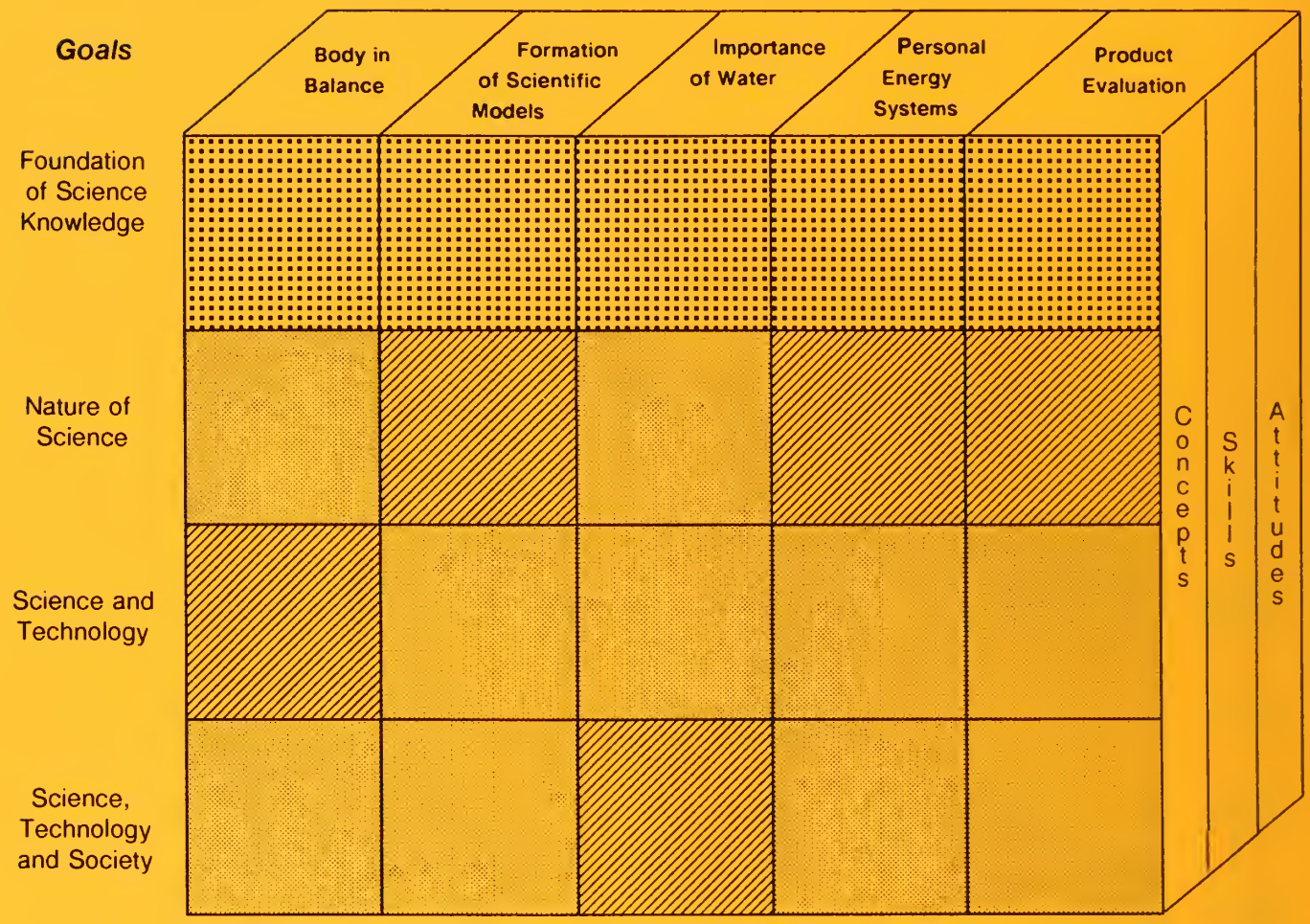


SCIENCE 30 SCOPE AND SEQUENCE
UNITS OF STUDY



SCIENCE 10 SCOPE AND SEQUENCE

UNITS OF STUDY



SCOPE AND SEQUENCE

UNIT I: Body in Balance

OVERVIEW

The emphasis of this unit is on science and technology.

Students will study biological science and technology in order to provide an introduction to the human body and its biological processes. The technology of monitoring, diagnosing, and treating selected systems of the human body will be studied.

Students will gain an understanding of the science and technology associated with health issues.

UNIT II: Formation of Scientific Models

OVERVIEW

The emphasis of this unit is on the nature of science.

Using the earth as a model, the unit focuses on the gathering of data used to explain forces of nature such as hurricanes, tornadoes, glaciers, volcanoes and earthquakes.

The analysis of data is used to support and revise current theories of the earth's structure, plate-tectonics and weather patterns.

Additional empirical evidence can be used to modify, expand or explain the model of the earth as it was initially presented.

UNIT III: Importance of Water

OVERVIEW

The emphasis of this unit is on science, technology, and society.

Students will examine the physical and chemical properties of water, and its biological importance. They will become aware of the issues concerned with water purity, distribution, and ownership.

UNIT IV: Personal Energy Systems

OVERVIEW

The emphasis of this unit is on the nature of science.

Drawing from a study of student's personal energy consumption, organization of energy systems into inputs, conversions and outputs should be clarified.

The concepts of measuring energy and converting energy are developed by analyzing student's personal energy consumption.

UNIT V: Product Evaluation

OVERVIEW

The emphasis of this unit is on the nature of science.

The specific design of the product evaluation will take into account available resources and expertise, and selection of appropriate controlled variables and hypotheses. The design will necessitate that the student become familiar with the characteristics and development of the consumer product selected for evaluation.

The product evaluation may be of original design or may duplicate and existing design.

Data collected when implementing the design should allow analysis and evaluation of existing data and/or specific claims made regarding the selected product.

UNIT I: BODY IN BALANCE

OVERVIEW

The emphasis of this unit is on science and technology.

Students will study biological science and technology in order to provide an introduction to the human body and its biological processes. The technology of monitoring, diagnosing, and treating selected systems of the human body will be studied.

Students will gain an understanding of the science and technology associated with health issues.

CONTENT

CONCEPTS

1. Normal function of body systems occurs within a range of values.

   a. Define homeostasis.
   b. Describe how homeostasis is regulated by nerves, hormones and enzymes.
   c. Explain the functions of homeostasis.
   d. Identify major body systems and their functions (e.g., respiratory, digestive, circulatory, lymphatic, nervous, endocrine, reproductive).
   e. Understand that body systems are dynamic and respond to shifts in activity level as circumstances change.
   f. Investigate the homeostatic relationship between two selected body systems.
   g. Know the "normal" range of function within two selected body systems.
   h. Understand how such "norms" are established and how they relate to the individual.
   i. Understand the concept of homeostasis encompasses interaction of all body systems.

2. Technology can be used to monitor the level of function in human systems.

   a. Understand the need to monitor biological processes.
   b. Identify the vital signs that can be easily monitored (e.g., heart rate, blood pressure, breathing rate, body temperature, blood gases).
   c. Identify the technologies used to monitor the vital signs (e.g., stethoscopes, thermometers, sphygmomanometers).
   d. Differentiate between qualitative and quantitative observations about the body systems.
   e. Obtain data for a particular body system using available technologies.
   f. Interpret the data with respect to defined normal ranges.
   g. Investigate more sophisticated technologies used to monitor body systems (e.g., ECG, EEG, fetal heart monitor).

3. Diagnosis and treatment of disease may involve technology.

   a. Understand that the term disease refers to a departure from homeostasis.
   b. Understand the relationships between diagnosis, prevention, treatment, and cure.
   c. Evaluate the effectiveness of a selected technique used in diagnosis, prevention, treatment, and cure of abnormality of function.
   d. Investigate some technologies used to identify the symptoms associated with disease (e.g., EMR, CAT, X-rays).
   e. Describe practical applications of technological devices or techniques used to substitute for or replace a normal homeostatic mechanism that is malfunctioning (e.g., pacemaker, artificial kidney, insulin pump).
   f. Discuss how our knowledge base is enhanced by technological advances particularly in the areas of diagnosis and treatment of diseases.

UNIT I: BODY IN BALANCE (cont'd)

4. Science and technology can enhance each other.

   a. Know and be able to give examples of how science can lead to advancements in technology and technology can lead to advancements in science (e.g., microscope-microbe discovery - disease link - antibiotics and immunization).
   b. Understand that medical technology is limited by a variety of factors (e.g., scientific knowledge, societal factors).
   c. Analyze the relationship between a biological process and the technology involved in its monitoring, diagnosis and treatment.

5. Medical science and technology can be used to optimize or maintain function of body systems.

   a. Understand that medical science and technology may be used to diagnose the level of activity of body systems, and prevent, treat, or cure conditions that cause abnormal levels of activity.
   b. Trace the development of a selected technique in terms of scientific knowledge and technology (e.g., surgery, open heart surgery, transplants, diabetes treatments, dental procedures).
   c. Realize that prevention, treatment or cure of certain conditions or abnormalities is currently beyond the capabilities of science and technology (e.g., Alzheimer's disease, cancer, muscular dystrophy).

SKILLS

1. Measure and analyze data about body functions.
2. Design an experiment to examine induced variations in the function of body systems.
3. Recognize the limits of science and technology in problem solving.
4. Identify variables involved in the development of technological processes, instruments, and products.

ATTITUDES

1. Appreciate that the human body is a system in dynamic balance.
2. Appreciate that many variables relate to the development of technological processes, devices or products and their applications.
3. Appreciate the relationship between science and technology.
4. Appreciate that knowledge about tolerance limits of normally functioning body systems has relevance to personal life style choices.

UNIT II: FORMATION OF SCIENTIFIC THEORIES AND MODELS

OVERVIEW

The emphasis of this unit is on the nature of science.

Using the earth as a model, the unit focuses on the gathering of data used to explain forces of nature such as hurricanes, tornadoes, glaciers, volcanoes and earthquakes.

The analysis of data is used to support and revise current theories of the earth's structure, plate tectonics and weather patterns.

Additional empricial evidence can be used to modify, expand or explain the model of the earth as it was initially presented.

CONTENT

CONCEPT

1. Empirical evidence is used to formulate models.

   a. Define and differentiate between the terms scientific law, principle, theory and model.
   b. Define the term empirical evidence and differentiate between quantitiative and qualitative evidence.
   c. Recognize the need for a theoretical model.
   d. Examine empirical evidence gathered from reliable sources for a meteorological or geological phenomenon.
   e. Investigate a current geological or meteorological model that clearly illustrates the use of empirical evidence in its formulation.
   f. Gather and organize empirical evidence for an easily monitored geological or meteorological phenomena.
   g. Analyze collected empirical evidence and compare with existing meteorological or geological evidence.
   h. Investigate the current model for the phenomena being studied.
   i. Specify the relationships satisfied by the model.

2. Scientific theories are used to explain major forces of nature.

   a. Identify major forces of nature and their location, occurrence and impact (e.g., crustal movements, volcanic action, hurricanes, tornadoes).
   b. Recognize the relationship between the earth's structure and the major forces of nature.
   c. Analyze methods of formulating theories.
   d. Outline a theory which attempts to explain a major force of nature (e.g., tornado formation, earthquake occurrence, glaciation).

3. Models can be used to support or illustrate theories.

   a. Understand that models may be used to explain those natural processes that occur either so quickly or so slowly that empirical data are difficult to collect (e.g., plate movement, glacial growth, volcanic activity, tornadoes).
   b. Understand that models may allow for a study of a limited aspect of a complex situation.
   c. Understand that models allow for the study of phenomena that are unpredictable, erratic or dangerous in nature (e.g., hurricanes, tornadoes, volcanoes, flooding).

UNIT II: FORMATION OF SCIENTIFIC MODELS (cont'd)

d. Understand that models may be used when the natural phenomena are of a scale which makes study difficult (e.g., continental glaciation, greenhouse effect, hurricanes).
e. Recognize that models are representatives of phenomena and are subject to verification and modification.

4. Theories are reformulated on the basis of new evidence.

a. Know the technology associated with accumulation of empirical evidence.
b. Describe a current geological or meteorological theory that has been subject to change (e.g., plate tectonics, age of earth).
c. Identify prior theories related to the current theory.
d. Identify all the empirical evidence presently known that relates to a selcted phenomena.
e. Investigate evolution of prior theories into the current theory as new evidence has been discovered.
f. Identify which empirical evidence remains unexplained by the current theory.

5. Models are often used for prediction.

a. Know that accepted models must fit existing evidence as well as serve to make predictions about future phenomena.
b. Investigate the use of current weather models to predict severe weather patterns or investigate the use of the plate tectonics model to predict long term geological changes.
c. Realize the importance of predictions based on accepted models in reducing injury and loss of life during dramatic weather conditions or geological phenomena.
d. Compare past and present geological or meteorological models on basis of data fit and ability to make accurate predictions.

SKILLS

1. Develop observation techniques.
2. Develop skills in interpretation of empirical data.
3. Develop the ability to look for patterns in nature.
4. Judge the usefulness of scientific models when the most recent empirical evidence is considered.
5. Recognize the limits of science in problem solving.
6. Recognize components and interactions within systems.

ATTITUDES

1. Appreciate that proposed theories may be supported or refuted by experimental results.
2. Recognize that scientific knowledge is cumulative and subject to change.
3. Appreciate the power of natural phenomena in shaping the earth.
4. Appreciate the relationship between science and technology.

UNIT III: IMPORTANCE OF WATER

OVERVIEW

The emphasis of this unit is on science, technology, and society.

Students will examine the physical and chemical properties of water, and its biological importance. They will become aware of the issues concerned with water purity, distribution, and ownership.

CONTENT

CONCEPT

1. Science can account for many of the chemical and physical properties and changes of water.

   a. Know the relationship between subatomic particles and atoms, atoms and elements, elements and compounds in reference to the periodic table.
   b. Describe the chemical composition and structure of water.
   c. Differentiate between chemical and physical properties and chemical and physical changes.
   d. Define and explain the following physical properties of water: phase changes, specific heat, density, colour, clarity, latent heat, viscosity, cohesion and surface tension.
   e. Explain how the combined effects of the molecular shape and electrical polarity of water molecules help to account for many of its properties.
   f. Differentiate among phases of matter with respect to physical properties, energy, arrangement of and attractive forces between molecules.
   g. Explain the phase changes of water in terms of physical changes, energy, arrangement of and attractive forces between molecules.

2. On earth, the natural existence of water in solid, liquid and gaseous forms is unique.

   a. Describe the hydrologic cycle.
   b. Analyze the hydrologic cycle in terms of the phase changes of water and it specific and latent heat.
   c. Understand the long term and short term aspects of the hydrologic cycle.

3. All life depends upon the purity and availability of water.

   a. Explain the ecological importance of water in relation to its physical and chemical properties.
   b. Explain the importance of water to living organisms in respect to composition, transport, lubrication, dissolving and temperature maintenance.
   c. Define quality of water.
   d. Provide examples that illustrate the relationship between quality of water and human use.
   e. Outline methods of water purification and sewage treatment.
   f. Provide examples of water pollution and know the effects on living organisms.

4. Personal water consumption can be determined.

   a. Itemize, chart, and compute average daily personal water consumption.
   b. Analyze personal life style to identify minimum personal water consumption.
   d. Evaluate personal choices that can be made to minimize water consumption.

UNIT III: IMPORTANCE OF WATER (cont'd)

5. Many societal factors are involved in water management.

   a. Explain the importance of water as a commodity in society.
   b. Map the distribution of water (e.g., lakes, rivers, precipitation) and correlate this to regional water requirements in Canada.
   c. Explain concerns associated with the distribution of water and water requirements in Canada.
   d. Provide evidence for the seasonal and annual variance in water demand.
   e. Define the concept of "sustained use" of resources.
   f. Demonstrate how sustained use of water redefines water management strategies.
   g. Identify issues facing Canadians regarding water research and management.
   h. Know examples of Canadian technologies used or being developed to manage water resources (e.g., new irrigation techniques, household water-saving devices).
   i. Apply a decision-making model to a societal issue related to water (e.g., water diversion, draining of wetlands, damming, export of water).

SKILLS

1. Draw simple models of the atom and the water molecule in order to understand its polarity and shape.
2. Collect time/temperature data for water as it is heated, graph the results and relate to the energy, attractive forces and arrangement of the molecules.
3. Examine the effects of human behaviour on the environment particularly as it relates to water.
4. Apply data collection, organization and interpretation skills to the study of water management.
5. Examine and assess a variety of viewpoints before forming an opinion on a societal issue related to water.
6. Utilize and evaluate various approaches for assessing and solving problems.
7. Develop and employ skills for assessing and processing information in a technologically advanced society.

ATTITUDES

1. Appreciate the interaction of societal factors such as economic, political, ethical, and moral forces with science and technology.
2. Appreciate the need for trade-offs in order to arrive at workable situations involving science and technology in society.
3. Possess an attitude of being in harmony with the environment.
4. Recognize the need to balance long-term environmental objectives with economic and societal needs.
5. Demonstrate awareness of global issues and the contribution of local activity to the resolution of global problems.

UNIT IV: ENERGY SYSTEMS

OVERVIEW

The emphasis of this unit is on the nature of science.

Drawing from a study of students' personal energy consumption, organization of energy systems into inputs, conversions and outputs should be clarified.

The concepts of measuring energy and converting energy are developed by analyzing student's personal energy consumption.

CONTENT

CONCEPTS

1. Energy can be measured in quantitative terms.

   a. List examples of different forms of energy.
   b. Formulate a definition for the term "energy".
   c. Identify, from personal experience, methods of quantifying energy.
   d. Identify and define the units for measuring various forms of energy (e.g., Calorie, Joule, kilowatt hour, B.T.U).
   *e. Demonstrate methods of converting from one energy measurement to another (e.g., conversion tables). * extension

2. A model of an energy system can be organized into input energy, conversion and output energy.

   a. Identify the input and output components in selected energy systems.
   b. Realize energy can be converted from one energy form to another.
   c. Describe qualitatively and quantitatively the conversion of energy in a given system.
   d. Trace the energy inputs, conversions and outputs of several different energy systems.
   e. Design an investigation that highlights an energy conversion (e.g., kinetic – potential, chemical – electrical, electrical – heat/light, mechanical – electrical).
   f. Analyze selected technologies in terms of energy system components (e.g., toaster, microwave, gasoline engine, water turbine).

3. According to the Law of Conservation of Energy, energy can be neither created nor destroyed.

   a. Understand that in any transfer or conversion of energy the total amount of energy remains constant.
   b. Research the scientific investigations that were done to support the formulation of the Law of Conservation of Energy.
   c. Understand that scientific explanations can be developed through observation and interpretation.
   d. Recognize that scientific laws and theories can be supported or refuted by experimental results.
   e. Design a model of a simple energy system to illustrate the Law of Conservation of Energy.

4. Energy can be lost from an energy system.

   a. Quantify the energy inputs and outputs of several energy systems.
   b. Understand that energy conversions result in a decreased amount of useful energy in a system.

UNIT IV: PERSONAL ENERGY SYSTEMS (cont'd)

c. Measure the energy input and useful energy output in a selected system.
d. Calculate the amount of energy apparently lost from a selected system.
e. Formulate a possible explanation for the apparent loss of energy from energy systems.
f. Recognize the importance of measurement in gathering empirical evidence about energy systems.

5. Efficiency of an energy system can be calculated.

   a. Understand that efficiency of an energy system relates to the ratio of energy input to useful energy output.
   b. Determine the efficiency of a selected energy system.
   c. Compare the energy efficiency of several selected energy systems.

6. Awareness of personal energy consumption patterns can facilitate responsible energy use.

   a. Itemize, chart and compute daily personal energy use (e.g,. consumption of electricity and fuels).
   b. Analyze personal lifestyle to identify minimum personal energy requirements.
   c. Evaluate personal energy alternatives in terms of efficiency (e.g., microwave or conventional oven, forced air or hot water heating).
   d. Apply knowledge of efficiency of alternative energy systems to make responsible choices regarding personal energy consumption.

SKILLS

1. Recognize the components and interactions within an energy system.
2. Prepare systems diagrams.
3. Demonstrate the ability to design a simple experiment.
4. Select the appropriate scientific skills for an investigation.
5. Demonstrate skill in measurement skills.
6. Develop psychomotor manipulative skills.
7. Calculate energy consumption or production using calorimetry.
8. Record and interpret data.
9. Graph Data.
10. Extrapolate, interpolate, and interpret graphs.
11. Use precise symbols and terminology of science and mathematics in oral and written communication.
12. Recognize the limits of science and technology in problem solving.
13. Develop and employ skills for accessing and processing information in a technologically advanced society.

ATTITUDES

1. Develop a positive attitude toward mathematical communication and scientific processes and skills.
2. Appreciate the usefulness of computational competence.
3. Develop responsible attitudes toward consumption as it is related to personal needs.
4. Be open to new ideas, insights and change.
5. Strive to develop a philosophy of life that reflects responsibility to self as well as to others in a highly complex and changing world.

UNIT V: SCIENTIFIC EVALUATION OF CONSUMER PRODUCTS

OVERVIEW

The emphasis of this unit is on the nature of science.

Scientific principles common to consumer products will provide background for the evaluation of a product. The specific product evaluation design will take into account available resources and expertise, and selection of appropriate controlled variable and hypotheses. The design will require the student to become familiar with the characteristics and development of the product selected for evaluation.

The product evaluation may be of original design or may duplicate an existing design.

Data collected when implementing the design should allow analysis and evaluation of existing data and/or specific claims made regarding the selected product.

CONTENT

CONCEPTS

1. Effective designs for safe consumer products are based on several common scientific principles.

    a. Demonstrate an operational understanding of the basic scientific principles of equilibrium and conservation (e.g., force, momentum and acceleration).
    b. Apply the concept of energy to such products.
    c. Recognize that friction often plays an important role in the product design.
    d. Recognize that the distribution of force over a larger area (pressure) has implication for many product designs.
    e. Understand how user anatomy and physiology is considered in product design.

2. Scientific investigation of consumer products can be used to establish legal requirements.

    a. Determine what the legal requirements of Alberta/Canada are in regards to such products.
    b. Where government legal requirements do not exist determine if other agencies have established guidelines (e.g., National Hockey League, car racing associations).
    c. Examine and interpret the scientific research used to support the establishment of such legal requirements (e.g., consumer protection laws).

3. Public acceptance of consumer products is determined by a large variety of factors.

    a. Understand the role of scientific research in this process.
    b. Identify the societal factors which affect the acceptance of such products (e.g., economic, political, ethical, social).
    c. Analyze the interaction of science, society and the technology of vehicle safety or sports equipment.
    d. Consider the role of ergonomics in product design.

4. Scientific procedures can be used by individuals to evaluate consumer products.

    a. Understand how user anatomy and physiology can be considered in product evaluation.
    b. Understand that specific aspects of consumer products can be investigated.

UNIT V: SCIENTIFIC EVALUATION OF CONSUMER SAFETY

c. Recognize the components of experimental design essential to the investigation.
d. Know that data are more meaningful when organized.
e. Describe how interpretation of experimental results is intergral to scientific investigations.

5. Assessment and consideration of further related work are important aspects of the scientific investigation of a product.

   a. Assess the various components of the investigation (e.g., hypothesis, equipment utilized, design).
   b. Recognize that some factors affecting the results of an investigation are beyond the control of the investigator.
   c. Formulate modifications that would improve those components of the investigation within the control of the investigator.
   d. Provide examples of practical applications arising from the investigation.
   e. Propose further studies that could be pursued relative to the investigation.

6. Communications of scientific investigations follows various conventions.

   a. Know conventions for communicating the results of scientific investigations to the scientific and non-scientific communities.
   b. Compare and contrast how the results of a scientific investigation are communicated in a variety of publications.
   c. Choose the method of communication of an investigation depending upon the processes to be emphasized and the intended audience.
   d. Employ acceptable conventions in the written communication of an investigation.

SKILLS

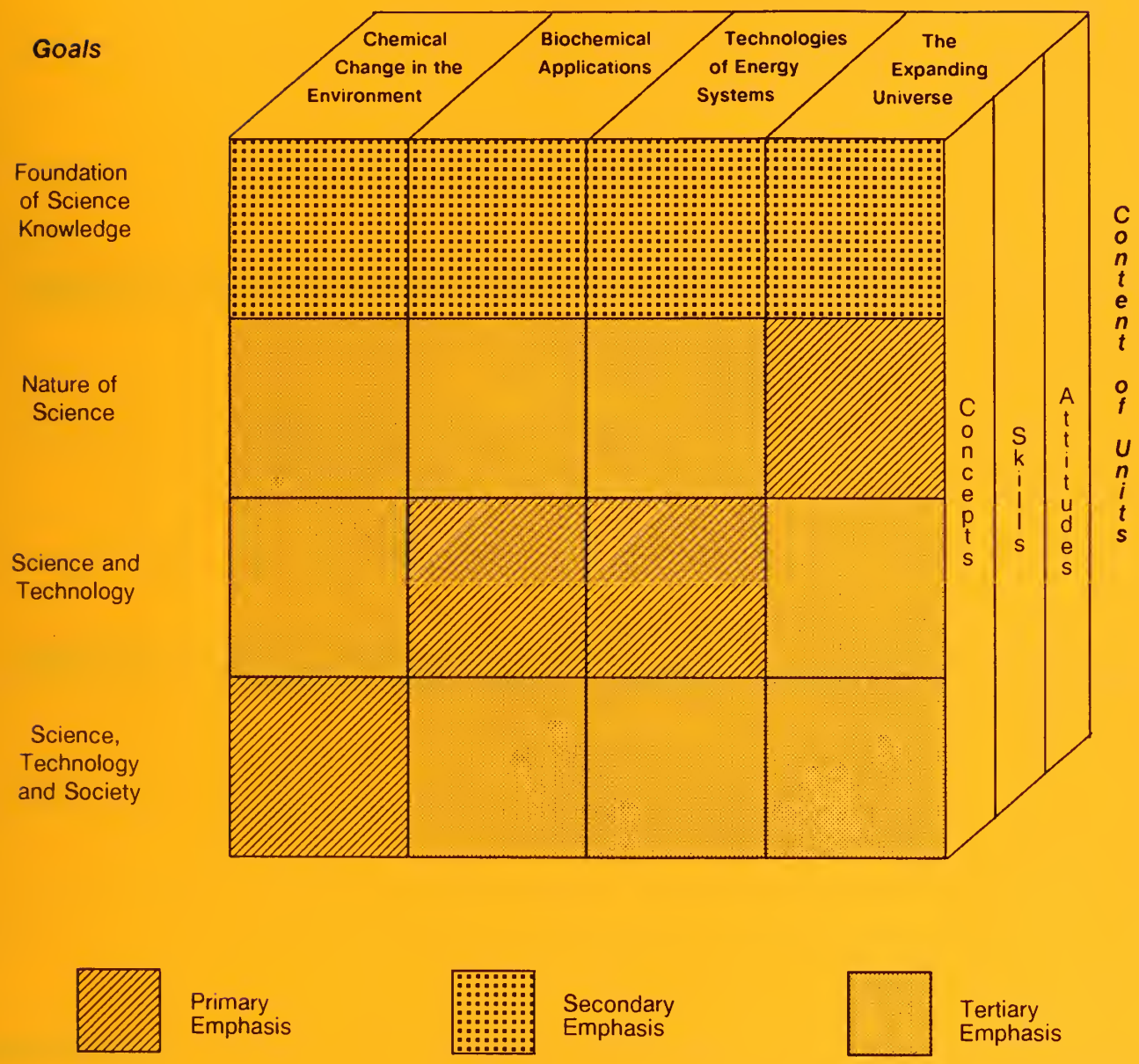
1. Show that empirical data play an important role in the development of scientific knowledge.
2. Develop skill in the processes of scientific experimental design.
3. Construct meaningful communications and analyze the communications of others.
4. Develop and employ skills for accessing and processing information about consumer products.
5. Understand the relationship between expectations of consumers and responsibilities of producers.

ATTITUDES

1. Appreciate that science is a disciplined way to develop explanations and descriptions for the events and objects of the natural and technological world.
2. Display an interest in consumer needs and consumer protection laws.
3. Appreciate the effects of advertising and the mass media on consumerism.
4. Develop a positive attitude toward mathematical and scientific processes and skills.
5. Appreciate the usefulness of problem-solving skills.
6. Appreciate that scientific knowledge is cumulative and subject to change.

SCIENCE 20 SCOPE AND SEQUENCE

UNITS OF STUDY



SCOPE AND SEQUENCE

UNIT I: Chemical Change in the Environment

OVERVIEW

The emphasis of this unit is on science, technology and society.

Using examples of chemical reactions occurring in the environment, students will develop an understanding of atoms, ions, bonding, chemical compounds and chemical reactions.

UNIT II: Biochemical Applications

OVERVIEW

The emphasis of this unit is on science and technology.

Technologies related to food production, preservation, and storage greatly influence lives. Students will gain an understanding of how biotechnologies have improved the quality of life and how Canadians have contributed to this field.

UNIT III: Technologies of Energy Systems

OVERVIEW

The emphasis of this unit is on science and technology.

Drawing on the students experiences with various forms of energy use in society, the concept of energy systems is developed.

Students will explore both renewable and non-renewable sources, and explore the technologies that allow us to use the energy in our homes, transportation devices, factories, offices.

UNIT IV: The Expanding Universe

OVERVIEW

The emphasis of this unit is on the nature of science.

Students will explore the historical development of models of the universe. They will use both Newtonian and relativistic concepts to solve problems involving motion in space.

Students will become aware of new technology that provide supportive evidence for the tentative nature of models. They are also to be aware that new information is constantly changing models of the universe.

UNIT I: CHEMICAL CHANGE IN THE ENVIRONMENT

OVERVIEW

The emphasis of this unit is on science, technology and society.

Using examples of chemical reactions occurring in the environment, students will develop an understanding of atoms, ions, bonding, chemical compounds and chemical reactions.

CONTENT

CONCEPTS

1. The periodic table is a convenient means of organizing the elements on the basis of their chemical properties.

    a. Trace the historical development of the periodic table.
    b. Discuss the societal factors that influenced eventual acceptance of Mendeleev's periodic table.
    c. Know the organization of the periodic table in terms of metals, non-metals and metalloids.
    d. Predict characteristics of elements, knowing their position on the periodic table.
    e. Investigate the chemical properties of a variety of elements and use these properties as a basis for classifying them.

2. Chemical compounds are composed of individual atoms or ions held together by chemical bonds.

    a. Recognize that chemical compounds are pure substances composed of atoms or ions in a definite ratio.
    b. Recognize that the chemical nature of constituent atoms determines whether ionic or covalent bonding occurs.
    c. Investigate the formation of ionic and covalent compounds.
    d. Recognize that knowledge about how atoms interact can lead to the production of synthetic compounds (e.g., aspartame, artificial flavourings, plastics, nylon, ASA, synthetic hormones).
    e. Realize that research in the field of chemistry is influenced by prevailing societal factors (e.g., alchemy, fashion, architecture, transportation, agriculture, petroleum industry).
    f. Understand that knowledge gained from the study of chemical compounds and atoms advances technological development in areas that positively affect society (e.g., recycling, hazardous wastes disposal, protein from unusual sources).

3. Chemical reactions involve recombinations of atoms.

    a. Classify chemical reactions as to basic type: composition (formation), decomposition, single or double replacement, combustion.
    b. Predict the products of the basic reaction types.
    c. Know the importance of reactions involving oxygen.
    d. Provide evidence for energy absorbing (endothermic) and energy releasing (exothermic) reactions (Law of Conservation of Energy).
    e. Understand that the number of atoms composing the reactants is equal to the number of atoms composing the products and that chemical equations can be balanced (Law of Conservation of Mass)

f. Understand the importance of chemical reactions which produce compounds significant to society (e.g., combustion cracking, polymerization).
g. Recognize that the raw materials for some chemical reactions are non-renewable.

4. Many chemical changes have a measurable heat effect

a. Review the technique of calorimetry.
b. Understand the combustion reaction by studying a number of examples (e.g., hydrocarbons, alcohols, waxes).
c. Recognize how energy from fossil fuels is useful to society.
d. Investigate the energy conversion sequence from fossil fuel to useful energy.
e. Evaluate the trade-off between the need for fossil fuels and their negative impact on the environment.

5. Chemical changes may affect the environment.

a. Analyze the significance of the combustion reaction in today's society particularly in regard to the greenhouse effect.
b. List the chemical sequence of events which leads to depletion of upper level atmospheric ozone and formation of acid rain, and relate this to the implications for society.
c. Research the effect and/or implications of human activity on lower level atmospheric ozone.
d. Investigate the effect of acid rain on metals in the soil (e.g., heavy metal problem).
e. Define pH and investigate shifts in pH caused by acid rain.
f. Define buffer and relate this to the varying buffering capacities of the bedrock in different regions of Canada.
g. Investigate the economic, political and technological problems associated with reducing or reversing the effects of acid rain.
h. Recognize that products and by-products of chemical reactions and processes may have future consequences for the environment.
i. Investigate how a chemical introduced into the environment has had lasting implications for society (e.g, DDT, mercury, PCBs, dioxin).

SKILLS

1. Use precise symbols and terminology of science and mathematics in oral and written communication.
2. Demonstration accepted and safe laboratory procedures in the study of substances and their reactions.
3. Analyze the possible impact of scientific research and technological development on society and the environment.
4. Utilize established scientific or mathematical models as a comparative basis for observed date.

ATTITUDES

1. Appreciate the ethical dilemmas that may arise from the application of scientific research and/or technological development.
2. Develop a positive attitude toward mathematical and scientific processes and skills.
3. Recognize the need for safety precautions in the laboratory.
4. Appreciate that in solving problems scientifically new technologies develop.
5. Appreciate that the production of new chemical substances is often a response to societial needs
6. Realize that many of the effects of chemical changes are unforeseen.
7. Appreciate the relationship among science, technology and society.

UNIT II: BIOCHEMICAL APPLICATIONS

OVERVIEW

The emphasis of this unit is on science and technology.

Technologies related to food production, preservation, and storage greatly influence lives. Students will gain an understanding of how biotechnologies have improved the quality of life and how Canadians have contributed to this field.

CONTENT

CONCEPTS

1. Food requirements and preferences are influenced by societal factors.

   a. Know the nutrients required for survival (e.g., proteins, fats, carbohydrates, minerals, vitamins and water).
   b. Trace the energy conversions and losses that occur in food chains.
   c. Discuss why eating a diet based primarily on plants is more energy efficient than eating one based on meats (e.g., rice as apposed to beef steak).
   d. Recognize how diet choices are influenced by the society in which we live.
   e. Understand that dietary supplements (e.g., vitamins and minerals - iron, calcium, etc.) may improve the health of people.
   f. Understand that some additives may increase the quality of food by increasing the nutrient content (e.g., vitamin D enriched milk).

2. Technology and biotechnology have increased the quality and quantity of food produced.

   a. Differentiate between technology and biotechnology.
   b. Recognize that new technologies and biotechnologies have increased the amount and variety of foods produced (i.e., the "green revolution").
   c. Understand how crop yields can be maximized by use of technologies designed to increase production (e.g., fertilizer use, crop rotation, plant breeding and selection, and use of herbicides, pesticides and biological controls to decrease crop pests).
   d. Contrast today's food production techniques with those of fifty years ago.
   e. Understand that by maximizing production and cutting crop or product loss, profit potential to producers, wholesalers and distributors as well as availability of crop or product to consumer is vastly increased.
   f. Evaluate why the green revolution has not significantly reduced global food shortages.

3. Food storage, preservation and processing techniques directly improve the quality of life.

   a. Realize storage techniques reduce crop/product loss and preserve/increase quality (e.g. grain driers, granaries, silos, seed cleaning, refrigeration, "atmospheric" storage, packaging of fruit and vegetables, transport methods).
   b. Know the factors that contribute to food spoilage (e.g., temperature, bacteria, amount of light and water).
   c. Know the current methods of food preservation (e.g., pressure canning, hot water bath canning, freezing, dehydration, chemical preservatives, vacuum packing).

d. Investigate by experimentation a food preservation method.
e. Investigate current research into food preservation techniques.
f. Know about processes which preserve/increase quality and convert food to other usable forms (e.g., production of vegetable oils such as that from canola, hydrogenation of vegetable oils, production of convenience foods such as breakfast cereals).
g. Contrast today's food storage, preservation and processing techniques with those of fifty years ago.
h. Investigate the quality of life related to food production and preservation in Canada and in a Third World country.

4. Scientific processes involved in the experimental phase require a scaling-up for the marketing phase.

a. Identify the criteria that must be satisfied before a new chemical food additive is introduced.
b. Identify the Canadian regulatory bodies and the processes involved in the introduction of a new chemical food additive.
c. Compare laboratory testing and controls to mass production.
d. Explain the term "quality control" as it pertains to marketing.
e. Investigate the relationship between societal factors (e.g., environmental concerns, tamper-proof products) and the factors that promote the marketability (e.g., packaging, appearance).

5. Many scientists have contributed to the field of biotechnology.

a. Identify Canadian scientists and their contribution to the field of biotechnology.
b. Identify a Canadian contribution that has influenced biotechnology globally.
c. Recognize the contributions of a pertinent Alberta scientist.
d. Identify a technology that has developed in response to a food production and/or storage problem (e.g., silos, grain dryers, farm implements, mushroom/sprout culture).

SKILLS

1. Use appropriate strategies in problem solving.
2. Apply data collection, organization, and interpretation skills.
3. Analyze data critically when making decisions.
4. Analyze critically the possible impact of scientific research and technological development in the food industry on society.
5. Discuss biotechnology in the food industry from several perspectives (e.g., legal, ethical, economic, social).
6. Use controlled experimentation.

ATTITUDES

1. Appreciate the ethical dilemmas that may arise from scientific and technological developments.
2. Appreciate the variety of factors that relate to the success of a given technological process.
3. Appreciate the interrelationships among science, technology, and society.
4. Appreciate the limits of science and technology in solving social problems.

UNIT III: TECHNOLOGIES OF ENERGY SYSTEMS

OVERVIEW

The emphasis of this unit is on science and technology.

Drawing on the students' experiences with various forms of energy use in society, the concept of energy systems is developed.

Students will explore both renewable and non-renewable sources, and explore the technologies that allow us to use energy in our homes, transportation devices, factories, offices.

CONTENT

CONCEPTS

1. Energy sources can be classified as renewable or non-renewable.

   a. Define the term 'energy source'.
   b. Recognize the various energy sources used in Canada.
   c. Classify current and alternative energy sources as renewable or non-renewable.
   d. Compare renewable and non-renewable Canadian energy sources in terms of cost of production, environmental impact and availability.
   e. Identify examples of how emerging technologies change the balance between the use of renewable and non-renewable energy sources.
   f. Analyze the factors that determine whether a renewable or non-renewable energy source should be exploited.

2. Availability of energy sources varies globally.

   a. Recognize that availability of an energy source is dependent upon current technology, physical access and cost of production.
   b. Understand that energy sources are not distributed evenly throughout the world.
   c. Identify that technology is used to solve the practical problem of obtaining energy.
   d. Recognize the variety of energy sources used globally.
   e. Analyze the effect energy availability has on the economic growth of a region.
   f. Delineate the social, political, economic, environmental and technological impact of increased energy requirements on a region.
   g. Given appropriate geographical and geological data of a region, construct a rationale for which energy sources should be used and for which energy systems should be developed.
   h. Analyze Alberta's use of energy sources.

3. Conversion of energy to useful energy involves technology.

   a. Understand the Law of Conservation of Energy.
   b. Understand that a single source of energy may be put to a variety of uses, each of which may involve different technologies.
   c. Understand that a single use of energy may be met with a variety of energy sources and technologies.

d. Recognize that energy sources may be separated from their places of use and that technology is involved in the transfer of this energy.
e. Investigate how the technologies of energy conversion, transmission, and extraction allow human habitation in areas and concentrations that were hitherto impossible.

4. Energy can be collected and stored.

   a. Understand the nature of technology as a process of solving practical problems of energy conversion and storage.
   b. Recognize the wide variety of methods by which energy can be collected and stored.
   c. Explain that technology places a limit on our ability to collect and store energy.
   d. Provide examples of how changing technology has enhanced our ability to collect and store energy from an energy source.
   e. Design and construct a simple energy conversion or storage device.

5. Different technologies vary in their efficiency of energy conversion and storage.

   a. Define the term efficiency as it applies to energy conversion.
   b. Analyze factors of an energy conversion system which reduce/enhance efficiency.
   c. Compare new and old technology in terms of efficiency.
   d. Postulate new energy conversion systems and the technological base required for implementation.
   e. Investigate reasons for human concern regarding the efficiency of energy conversion systems.

SKILLS

1. Understand and apply data collection, organization, and interpretation skills.
2. Use appropriate strategies in problem solving.
3. Analyze data mathematically.
4. Use precise science terminology in oral and written communication.
5. Recognize the components and interactions within systems.
6. Analyze critically the possible impact of scientific research and technological development on energy systems.
7. Quantitatively demonstrate ways to make efficient use of resources.
8. Be able to build a simple energy conversion or storage device.

ATTITUDES

1. Appreciate that in solving scientific problems, new technologies and problems develop.
2. Appreciate the relationship between science, technology and society.
3. Appreciate the theoretical and manipulative skills involved in creating technology.
4. Be concerned with the wise use of the natural resources.
5. Value the development of information, science and technologies, while continuing to cultivate human values and to be responsive to human needs.
6. Value both cooperation and competition as they are played out in world economic systems, and the resultant impact on society.
7. Appreciate the advantages of using renewable energy sources.
8. Appreciate economic considerations with respect to choice of energy and technologies.

UNIT IV: THE EXPANDING UNIVERSE

OVERVIEW

The emphasis of this unit is on the nature of science.

Students will explore the historical development of models of the universe. They will use both Newtonian and relativistic concepts to solve problems involving motion in space.

Students will become aware of new technologies that provide supportive evidence for the tentative nature of models. They will also be aware that new information is constantly changing our model of the universe.

CONTENT

CONCEPTS

1. Models of the universe have changed over time.

    a. Recognize and explain the following terms: universe, galaxy, star, star cluster, constellation, nebula, planet, satellite, asteroid, comet, meteor, meteorite, rotation and revolution.
    b. Develop a historical perspective for models of the universe.
    c. Compare and contrast geocentric and heliocentric models of the universe.
    d. Develop an understanding that science is the foundation for changing models of the Universe by analyzing supporting and contradicting evidence that results in change.
    e. Explain how new technology has had an impact upon our acquisition of knowledge and thereby altered our models of the universe (e.g., the technology of the lens led to the telescope, which, in turn, extended and changed our knowledge about the universe).
    f. Investigate the current models of the universe.
    g. Specify the scientific evidence supporting the current models.
    h. Recognizes that current models of the universe are subject to verification or revision.

2. Many principles of physics are the basis for the technology of astronomy.

    a. Know which parts of the electromagnetic spectrum are used by astronomers.
    b. Know and apply the properties of electromagnetic spectrum as applied by astronomers (e.g., reflection, refraction, parallax, inverse square law for light, $\lambda = c/f$).
    c. Investigate the development of the telescope from Galileo's time to present day.
    d. Understand quantitative principles of lenses and mirrors as applied to telescopes.
    e. Describe a telescope's performance in terms of light-gathering strength, resolution and power.
    f. Describe the continuous spectrum of visible light, and extend the description to include infrared and ultraviolet regions.
    g. Understand that most knowledge about objects in the universe is obtained from an analysis of radiation.
    h. Know that the elements produce line spectra unique to the element, and these line spectra are used to identify the composition of the universe.

i. Describe the formation of emission and absorption line spectra.
j. Explain how emission and absorption line spectra can be used to determine the composition of gas and a star.
k. Explain how Wein's Law provides information about the surface temperature of a star.
l. Analyze luminosity - temperature diagram for the sun and stars--and interpret the main sequence, red supergiant, red dwarf and white dwarf regions in terms of the following properties: luminosity, temperature, diameter, mass and density.
m. Explain the significance of changes in either coordinate on the luminosity-temperature graph.

3. The physical universe exhibits phenomena that can be described in terms of mathematical relationships.

a. Investigate the development of Kepler's Laws pertaining to elliptical orbits.
b. Apply Kepler's Laws to satellites and other objects in elliptical orbits.
c. Investigate the development of Newton's Laws of Motion and Gravitation.
d. Apply Newton's Laws of Motion and Gravitation when solving problems related to satellites, space probes and space stations.
e. Know how Einstein's Theory of Relativity applies to astronomy (e.g., blackholes).
f. Apply the Doppler Effect to astronomy (expansion of the universe; rotation of galaxies; massive galaxy centres)

$$f' = f \frac{(c - u)}{\sqrt{c^2 - u^2}}$$

g. Calculate astronomical distances, using parallax, applying the inverse square law for light and astronomical units (A.U.)

SKILLS

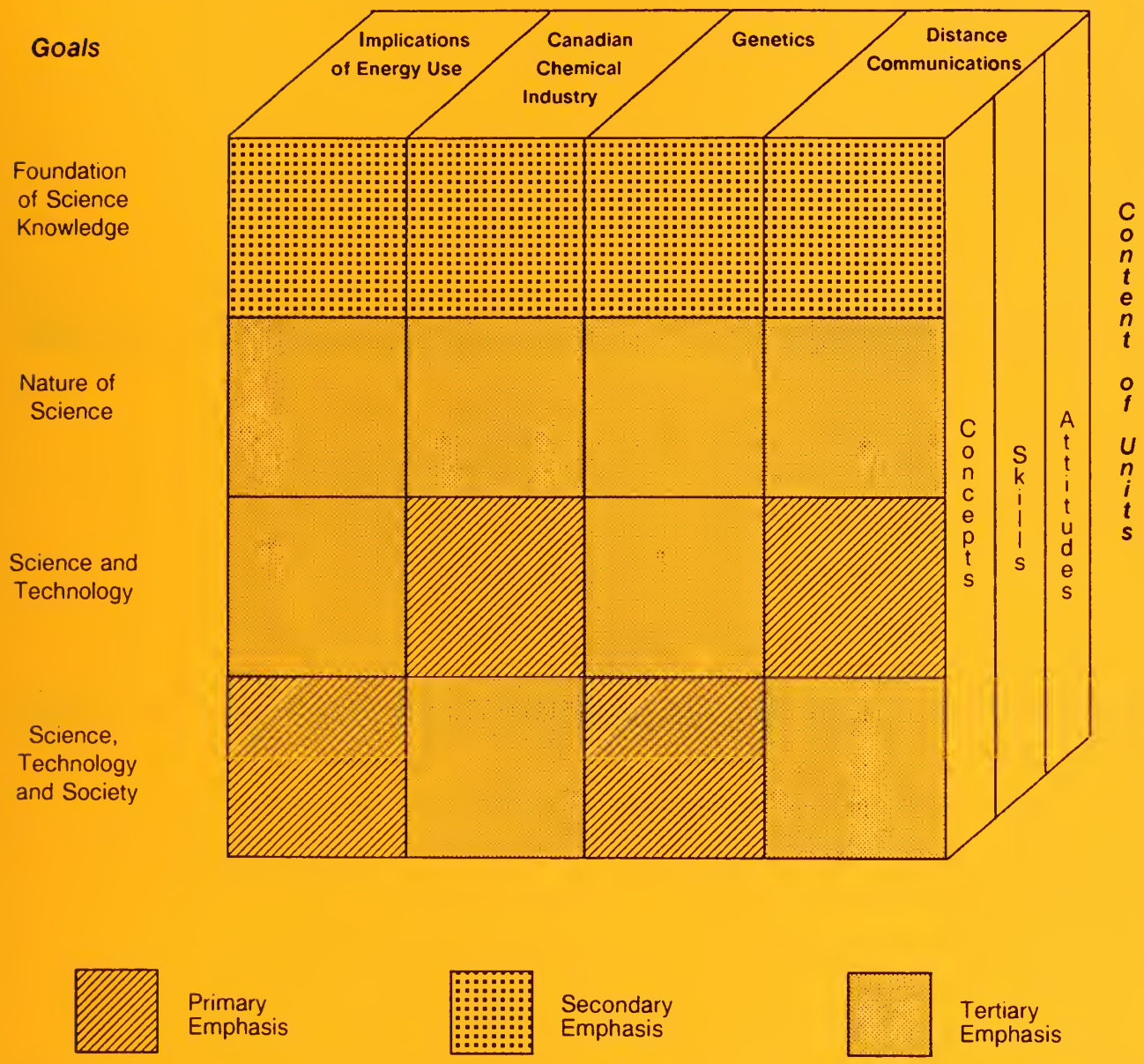
1. Demonstrate knowledge and understanding of basic mathematical skills.
2. Understand and apply data collection, organization and interpretation skills.
3. Use calculators and computers to aid in the solution of problems.
4. Use appropriate strategies in problem solving.
5. Apply the principles of scientific method to specific physical questions.
6. Utilize established scientific models as comparative bases for observed data.
7. Recognize components and interactions within systems.
8. Recognize the characteristics of scientific theory.

ATTITUDES

1. Value the contribution of science and mathematics to our cultural heritage and to the progress of civilization.
2. Recognize that as new observations become available--sometimes through the development of new technologies--theories and models have to be altered or rejected.
3. Realize that conflict arises when scientific theory is taken as fact or dogma.
4. Appreciate the beauty and grandeur of the universe.
5. Realize the limits in our knowledge of the universe.

SCIENCE 30 SCOPE AND SEQUENCE

UNITS OF STUDY



SCOPE AND SEQUENCE

UNIT I: Implications of Energy Use

OVERVIEW

The emphasis of this unit is on science, technology and society.

Current and future uses of energy and its implications will be developed from a personal and regional point of view.

The global energy balance will be discussed, with a particular focus on the "greenhouse effect".

UNIT II: Canadian Chemical Industries

OVERVIEW

The emphasis of this unit is on science and technology.

The study of the industrial preparation of metals, petrochemicals, fertilizers, and other commercial products will be used to illustrate the nature of science and technology and the interrelationship between them. Examples of careers in chemistry will be included in the study.

UNIT III: Genetics

OVERVIEW

The emphasis of this unit is on science, technology and society.

By examining issues related to genetics, students are to gain an understanding of the science. Students will consider the problems associated with the applications of genetics to the production of specialized organisms for use in industry.

UNIT IV: Distance Communications

OVERVIEW

The emphasis of this unit is on science and technology.

A historical look at the telephone and the scientific principles behind it leads students into the concepts of electrostatics and electricity. Combining these principles with those of the electromagnetic spectrum provides a basis for modern communication and optical technologies.

By examination of the current technology being used for satellites, laser optics, and computers, the students will speculate on future applications of emerging technologies.

UNIT I: IMPLICATIONS OF ENERGY USE

OVERVIEW

The emphasis of this unit is on science, technology and society.

Current and future uses of energy and its implications will be developed from a personal and regional point of view.

The global energy balance will be discussed, with a particular focus on the "greenhouse effect".

CONTENT

CONCEPTS

1. Use of energy has an impact on the environment.

   a. Realize the use of energy has an impact on the environment in a variety of ways (e.g., obtaining and/or refining processes, utilization methods, transmission/transportation, by-products of above processes).
   b. Investigate the situation in Alberta in regard to fossil fuel production, utilization, transportation and pollution (consider weather patterns).

2. Availability of energy resources varies globally.

   a. Review global energy resource distribution.
   b. Define availability in terms of:
      - resource location
      - appropriate technology for extraction and utilization
      - transport of resource
   c. Compare Canadian energy resource availability with the global scene.
   d. Analyze the relationship between available energy resources to their impact on the "greenhouse effect".

3. Patterns of energy use are factors in determining responsible global energy consumption.

   a. Investigate patterns of energy use in different cultures.
   b. Understand that energy use varies quantitatively and qualitatively in various regions and societies throughout the world.
   c. Analyze energy production and use in terms of global patterns.
   d. Recognize that economic and societal factors determine energy distribution patterns.
   e. Recognize that energy use produces products and by-products i.e. acid rain, hazardous wastes, greenhouse effect, which may alter the ecosystem in which they are generated.

4. Energy use involves economic and political factors.

   a. Analyze the problems associated with obtaining fossil fuels from the Middle East.
   b. Realize the factors involved with Alberta selling fossil fuels to Central and Eastern Canada.
   c. Analyze the approach toward the development of non-conventional fossil fuel sources in Canada.

d. Evaluate the economic and political factors involved in the development of nuclear power.
e. Evaluate the economic and political factors involved in the development of hydropower.
f. Propose the need for unusual or underdeveloped energy sources.

5. When planning for the future, our dependencies on energy need to be considered.

a. Realize that energy consumption varies between industrially developed countries and Third World countries.
b. Investigate the potential for various energy resource uses across Canada (i.e., areas with potential for a specific energy resource).
c. Realize that a variety of societal factors will impact on energy needs in the future (e.g., recycling, utilization).
d. List the energy factors that may be used to determine future expansion of industry in Canada.
e. Recognize the societal conflicts with respect to use of atomic (fission) energy to fulfil future energy requirements.
f. Hypothesize possible societal factors that appear to limit research on new sources of energy.

6. The energy balance of the planet is delicate.

a. Analyze the "greenhouse effect" in terms of factors which affect the model.
b. Recognize those factors within the model that can be affected by human activity, in terms of energy.
c. Analyze the disproportionate uses of energy in global terms as they relate to the model.
d. Predict the effect upon the model of such activities as increased fossil fuel consumption, deforestation, increased atmospheric particles, etc.
e. Formulate a plan that would stabilize the atmospheric carbon content.

SKILLS

1. Evaluate the efficiency and impact of alternative energy systems.
2. Examine social and political systems that influence energy resource policy.
3. Develop predictions based on available data.
4. Evaluate various existing models of global energy balance.
5. Speculate on the possible impact of scientific research and technological development on the use of energy in society.
6. Recognize the components and interactions within systems.

ATTITUDES

1. Appreciate the relationships among science, technology and society.
2. Possess an attitude of being in harmony with the environment.
3. Concern over the wise use of energy resources.
4. Appreciate the need to balance long-term environmental and energy objectives with economic and social needs.

UNIT II: CANADIAN CHEMICAL INDUSTRIES

OVERVIEW

The emphasis of this unit is on science and technology.

The study of the industrial preparation of metals, petrochemicals, fertilizers, and other commercial products will be used to illustrate the nature of science and technology and the interrelationship between them. Examples of careers in chemistry will be included in the study.

CONTENT

CONCEPTS

1. Science and technology are the foundations of industry.

   a. Differentiate the terms industry, science, and technology.
   b. Describe the difference between scientific and technological problem-solving models.
   c. Study the factors to be considered in the successful establishment of an industrial plant (e.g., source and transport of raw materials, markets, human resources, economic factors, environmental concerns, social impact).

2. The method of extracting metals from their ores is related to their electrode potential.

   a. Relate the concept of electronegativity to atomic structure.
   b. Understand oxidation - reduction reactions as electron exchanges.
   c. Apply the knowledge of redox reactions to the extraction of metals (e.g., Down's cell, Hall's cell and Chloro-alkyl cell).
   d. Understand corrosion as an oxidation-reduction reaction.
   e. Recognize the economic significance of corrosion to an industrialized society.

3. Organic chemistry is the study of the molecular compounds of carbon.

   a. Know the structures of the organic compounds which are the basis of Alberta's petroleum and petrochemical industries.
   b. Understand the basic reactions that these organic compounds may undergo (e.g., catalytic cracking, polymerization, synthesis of ethanol).
   c. Understand that technical application of chemical reactions provides products desired by society with emphasis on Alberta petrochemical industry.
   d. Illustrate that organic compounds are widely used in society.
   e. Recognize that the major source of organic compounds is non-renewable and new technologies must be developed to produce desired products from renewable sources.
   f. Describe the role of research in keeping Alberta's petrochemical industry competitive.

4. Nitrogen, phosphorus, and sulfur are used to produce inorganic fertilizers.

   a. Know basic terminology and conventions specific to fertilizers.
   b. Describe the importance of fertilizers to Canadian society.
   c. Understand the basic scientific concepts pertinent to the production and use of inorganic fertilizers.
   d. Know and describe chemical and technological processes and devices used in the production of inorganic fertilizers.

5. Chemical industries require an abundant source of raw materials and energy.

    a. Understand that most are not found in the elemental state but must be isolated chemically.
    b. Recognize that large quantities of raw materials are utilized by industrialized countries.
    c. Realize that accepted industrial processes are energy demanding.
    d. Investigate the factors that make a chemical industrial process efficient (sulphur utilization).
    e. Analyze a specific metallurgical industry in Canada with respect to energy and raw materials.
    f. Recognize that the transportation industries require large amounts of energy and that they are essential to chemical industries.

SKILLS

1. Use precise symbols and terminology of science and mathematics in oral and written communication.
2. Use established scientific or mathematical models as comparative bases for observed data.
3. Analyze critically the possible impact of scientific research and technological development on society.
4. Recognize the components and interactions within a system.
5. Identify the steps involved in career preparation for Canadian chemical industries.

ATTITUDES

1. Appreciate the usefulness of computational competence and problem-solving skills.
2. Appreciate the relationship among science, technology, and society.
3. Appreciate the value of all types of work and the workers who contribute to a productive society.
4. Realize that career preparation must take into account career changes that may occur throughout life, due to technological advances.
5. Value the role of scientific research and development in chemical industries.

UNIT III: GENETICS

OVERVIEW

The emphasis of this unit is on science, technology and society.

Students will gain an understanding of genetics by examining related issues. Implications associated with the development of genetically altered organisms will be considered.

CONTENT

CONCEPTS

1. Genetics is the study of heredity and variation.

   a. Understand that individual characteristics are the result of the interaction between genetic and environmental factors.
   b. Know that hereditary characteristics are determined by genes.
   c. Understand that cell division may result in cells with a genetic composition which is identical (mitosis) or different (meiosis) from the parent cell.
   d. Understand how fertilization affects the variation of individual characteristics.

2. The work of Gregor Mendel helped to explain the transmission and distribution of genetic material.

   a. Examine the work of Gregor Mendel in developing the principles of heredity.
   b. Examine the societal factors that contributed to the non-acceptance of Mendel's work for approximately 35 years.
   c. Show how Mendel's Laws of Segregation and Independent Assortment relate to the formation.
   d. Describe how dominant, recessive and incompletely dominant genes affect phenotype.
   e. Use Punnett squares to show the transmission of genes in monohybrid and dihybrid crosses. f. Discuss probability in predicting genotypic and phenotypic ratios.
   g. Analyze a pedigree study to determine the probability of a particular trait.

3. The genetic material must be versatile yet very precise.

   a. Know that the genetic material is mainly composed of DNA and occasionally RNA.
   b. Investigate the model of DNA and understand how the DNA codes genetic information.
   c. Summarize the role of DNA and RNA in protein synthesis.*
   d. Describe how protein synthesis is related to genetic control of characteristics.* * extension topicsc. of sex cells.

4. Genetic variability can be increased by mutations.
   a. Differentiate between gene mutations and chromosomal mutations and give examples of each
   b. Illustrate with examples how the DNA model accounts for gene mutations.
   c. Differentiate between genetic disorders and genetic diseases.
   d. Identify factors that increase the rate of mutation and analyze how living in a highly industrialized society may contribute to an accelerated mutation rate.
   e. Explain why some mutations may not be detected for a long period of time.

5. The diagnosis and treatment of genetic diseases is a challenge to medical technology.

   a. Predict the probability of inheriting selected genetic diseases (e.g., CF, Tay-Sach's, Huntington's chorea, diabetes mellitus, PKU)
   b. Investigate the methods of diagnosing genetic diseases. (e.g., chromosomal analysis, pedigree study, biochemical analysis)
   c. Understand the role of genetic screening and counselling in disease inheritance.
   d. Study current methods of treating genetic diseases.
   e. Evaluate how successful medical treatment of genetic disease is affecting the human gene pool.

6. Genetic engineering manipulates genotype

   a. Survey several different approaches that are currently used to manipulate genotype.
   b. Define the terms genetic engineering , recombinant DNA, gene splicing, and cloning
   c. Outline the techniques of recombinant DNA (e.g., restriction enzymes, ligase, plasmids)
   d. Investigate the technology involved in genetic engineering and follow the procedure sequentially through an example (e.g., synthesizing human insulin).
   e. Understand the value of genetic engineering (e.g., production of valuable chemicals by bacteria).
   f. Evaluate the potential hazards and/or implications of genetic engineering.

7. Applications of genetic engineering and biotechnology involve social issues.

   a. Evaluate society's concerns regarding the implications of genetic engineering (e.g., safety, ethics of creating new life forms, selection for particular characteristics).
   b. Evaluate society's concerns about the use of laboratory animals for researching biotechnology (e.g., ???).
   c. Assess biotechnological research with respect to enhancement of "quality of life".

SKILLS

1. Apply data collection, organization, and interpretation skills.
2. Develop and refine skills of observation.
3. Predict effects of continued scientific research in genetic engineering on society.
4. Identify and analyze factors involved in successful application of genetic engineering and cloning.
5. Apply laws of probability to analyze genetic ratios.

ATTITUDES

1. Appreciate the ethical dilemmas that may arise from the application of scientific and technological developments.
2. Appreciate that new technologies are often developed in response to a problem.
3. Appreciate the variety of factors that relate to a given technological process.
4. Appreciate the interrelationships among science, technology, and society.
5. Appreciate the limits of science in solving social problems.
6. Respect the differences among people that result from genetic variability.

UNIT IV: DISTANCE COMMUNICATIONS

OVERVIEW

The emphasis of this unit is on science and technology.

A historical look at the telephone and the scientific principles behind it, leads the student into the concepts of electrostatics and electricity. Combining these principles with those of the electromagnetic spectrum provides a basis for modern communication and optical technologies.

By examining current technology being used for satellites, laser optics, and computers, the students will speculate on future applications of emerging technologies.

CONTENT

CONCEPTS

1. The development of distance communications technology is of historical and scientific significance.

   a. Know electricity has played a central role in the development of distance communication.
   b. Understand that Morse, building on the discoveries of Volta, Oersted, and theory, transmitted a coded message using electricity.
   c. Analyze a time-line to recognize the historical importance of the invention of the telephone and the radio.
   d. Understand how a telephone works.
   e. Understand how a radio works.
   f. Know current technological advancements in telephones (e.g., electronic microphone, fiber-optics, cordless telephone, cellular telephone, digital signaling).

2. Scientific principles of electrostatic, current electricity, electromagnetic spectrum and electronics are the foundation of communications technology.

   a. Know the principles of electrostatics that lead to the development of Columb's Law.
   b. Comprehend the terminology associated with current electricity: resistance, electric potential differences, electric current, and power.
   c. Know Ohm's Law.
   d. Have a basic understanding of field theory.
   e. Understand the principles of electromagnetic induction.
   f. Know which parts of the electromagnetic spectrum are used for communication (e.g. radio frequencies and visible light).
   g. Know the properties of the electromagnetic spectrum used for communication (e.g., wave length, frequency, speed, reflection and refraction).
   h. Understand the fundamental principles that are the basis of traditional electronics, (e.g., the simple semi-conductor, transistor).

3. Technology has increased the opportunities for communication.

   a. Understand that telecommunications technology has increased the number of people with whom we may communicate.
   b. Understand that telecommunications technology has increased the variety of ways in which we can communicate.
   c. Predict how emerging technologies will increase opportunities to communicate.

d. State factors that may affect decisions in the selection of a particular mode of telecommunication.
e. Describe how increased technology in communication may make communication more impersonal.
f. Describe a not-so-distant future when current technology and technology under development are in widespread use.
g. Recognize that telecommunications technologies are not equally available to all (e.g., handicapped, underdeveloped nations).

4. Satellite communications technology has extended our range of communications.

a. Analyze the development of civilian and military satellite technology.
b. Investigate the evolution of Canadian satellite technology from Alouette to the Anik.
c. Understand the operation of antennas in communication with satellites (e.g., satellite T.V.).
d. Review Newton's Law of Motion and Gravitation as applied to satellites.
e. Develop quantitative understanding of geosynchronous orbits.
f. Know that computers (digital communications) enhance communication by allowing greater accuracy and clarity.

5. The development of satellite communications technology has advanced our understanding of the earth and the universe.

a. Investigate satellite technology used to study the atmosphere and the surface of the earth.
b. Investigate satellite technology used to study the universe (optical telescope, X-ray telescope, and UV telescope).
c. Understand that communication links with space craft that leave the earth's orbit are vital.
d. Know how the components of simple and two-way telemetry data communications function.
e. Investigate the function and data communication of a space probe such as Voyager.
f. Describe how satellites and probes will enhance man's knowledge of space.
g. Develop a time chart indicating the dates when various technologies related to advancing our knowledge of the earth and the universe were first used.

SKILLS

1. Develop and refine skills in observation.
2. Apply the principles of scientific method in exploring a device.
3. Use precise symbols and terminology of science in both written and oral communication.
4. Recognize components and interactions within systems.
5. Develop lateral thinking in considering alternative uses or future uses of technology.
6. Develop skills involved in manipulating an electronic device.
7. Analyze critically the possible impact of scientific research and technological development on society.

ATTITUDES

1. Appreciate that in solving problems scientifically, new technologies develop.
2. Value the contributions of science and mathematics to our cultural heritage and to the progress of civilization.
3. Appreciate the relationship between science and technology.
4. Have an awareness of the importance of technology in our daily lives.
5. Appreciate that technology can be understood by the average person.
6. Appreciate ethical dilemmas that may arise from the application of scientific research and/or technological developments.
7. Know that technologies developed for one purpose can often be applied to many different areas.

LB 1629-5 A3 A35 1978 GR-10-12
ADO-SC-2 1988
PROGRAM OF STUDIES FOR SENIOR
HIGH SCHOOLS --
39897100 CURR HIST

000026489575

DATE DUE SLIP

F255